Critical Care

CORRESPONDENCE

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Capillary refill time as an additional triage criterion to decide ICU admission of deteriorating obstetric patients

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Reduction of maternal mortality remains a global public health priority, of particular interest in the developing world [1]. Prompt detection and treatment of physiological derangements are critical to avoid adverse maternal and neonatal outcomes associated with obstetric emergencies, such as hemorrhage, hypertensive disorders, and sepsis. Indeed, the implementation of rapid response teams has been shown to improve outcomes in the obstetric population [2]. Simple and cost-effective monitoring tools for triage are essential not only for the early identification of patients but also for facilitating the initiation of supportive treatment and optimization of resource allocation [3]. However, such tools are currently lacking for this population.

Capillary refill time (CRT) is a simple diagnostic test that reflects skin perfusion and has been proposed as a marker of tissue hypoperfusion in both shock states and other conditions [4]. It has become a widely used clinical parameter as it is cost-free, universally available, and easily performed at the bedside. Unfortunately, there is a paucity of data regarding the role of CRT in the obstetric triage scenario. This study aimed to evaluate the potential usefulness of CRT as an additional triage criterion to identify the risk of ICU admission among obstetric patients assessed by a rapid response team (RRT) in an obstetric hospital.

We conducted a prospective observational study at a tertiary obstetric hospital in Ciudad de México, México. Consecutive patients in the third trimester of pregnancy or early postpartum period in the obstetric ward, for whom the RRT was activated between November 2021 and March 2024, were included. Exclusion criteria comprised patients admitted directly to the ICU from the ED or operating room, as well as pregnant patients who deteriorated in the wards following non-obstetric surgical interventions. We recorded physiological variables and commonly used severity scores, including the MEOWS score, universal vital assessment (UVA), and the obstetrically modified quick SOFA (omqSOFA) score. CRT was measured using a standardized method recommended in the literature, with a cutoff of 3.5 s [4]. The primary outcome of this study was ICU admission. ICU admission was decided on a case-by-case basis by the RRT team leader, considering the clinical context, bed availability, and their clinical gestalt, without predefined admission criteria.

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During the study period, the RRT assessed 1448 obstetric patients hospitalized in the obstetric ward (Supplemental Fig. 1). Among the study population, 891 (61.5%) patients were pregnant, while 557 (38.5%) were in the postpartum period. A total of 110 patients (7.6%) were finally admitted to the ICU. The primary causes for admission were hypertensive disorders (51%), hemorrhage (17%), and septic shock (15%).

Supplemental Table 1 compares the prevalence of baseline physiological derangements between patients admitted to ICU and those who stayed in the wards. At RRT assessment, prolonged CRT was observed in 47.3% of patients admitted to ICU, compared to only 2.5% of those who were not ($p < 0.001$). Among ICU-admitted patients, those with abnormal CRT at triage required more life support interventions (23% vs 8%, $p = 0.039$). Furthermore, 56 patients (51%) with hypertensive disorders of pregnancy that required ICU admission had an abnormal CRT at triage.

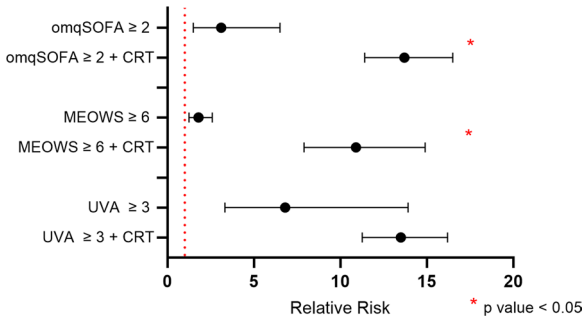

Fig. 1 Impact of integrating capillary refill time into frequently used severity scoring on the relative risk of intensive care unit admission of deteriorating obstetric patients. omqSOFA: obstetrically modified quick sequential organ failure assessment; MEOWS: Modified Early Obstetric Warning System; UVA: universal vital assessment

Table 1 shows the univariate relative risk (RR) and the area under receiver operating curve (AUROC) of physiological variables to predict ICU admission, while multivariate analysis of statistically significant variables is shown in Supplemental Table 2. When analyzing their diagnostic characteristics, only an altered CRT and estimated bleeding > 1000 cc had a positive likelihood ratio (LR+) > 10, as shown in Supplemental Table 3. Supplemental Table 4 shows that CRT maintains its overall diagnostic accuracy in both hypertensive disorders of pregnancy and hypotensive syndromes. Supplemental Table 5 shows the diagnostic accuracy of different severity scoring systems to predict ICU admission, along with the impact of incorporating CRT to improve their diagnostic yield. Figure 1 depicts the impact of integrating CRT into the RR of ICU admission for each of these scores.

Our study showed that no single vital sign at triage had adequate diagnostic accuracy to identify patients requiring ICU admission, besides an altered CRT and an estimated bleeding > 1000 cc. Notably, frequently used scores for obstetric emergencies, such as omqSOFA and MEOWS, did not perform adequately either. These findings align with results from other emergency triage scenarios, where clinical gestalt has been shown to outperform scoring systems [5]. However, integrating CRT with these scores significantly enhanced their

Table 1 Relative risk of deranged physiological variables and their area under curve (AUC) to predict ICU admission

Variables	Relative Risk (95% CI)	p-value	AUC (95% CI)	p-value
Tachycardia	4.1 (2.4–7.0)	0.001	0.54 (0.48–0.6)	0.16
Bradycardia	5.3 (1.8–15.9)	0.002	0.51 (0.45–0.56)	0.78
Systolic hypotension	1.34 (0.8–2.3)	0.26	0.52 (0.46–0.57)	0.55
Systolic hypertension	3.17 (1.7–6)	0.0013	0.52 (0.47–0.58)	0.36
Diastolic hypotension	1.1 (0.17–7.2)	0.9	0.5 (0.44–0.55)	0.98
Diastolic hypertension	2.7 (1.9–4.0)	0.0001	0.58 (0.52–0.64)	0.003
Shock index	1.9 (1.2–2.9)	0.004	0.54 (0.48–0.6)	0.1
Temperature > 38 °C	2.2 (0.4–13.3)	0.3	0.5 (0.44–0.56)	0.9
Mild bleeding (100–500 mL)	0.9 (0.6–1.5)	0.67	0.5 (0.45–0.56)	0.78
Moderate bleeding (500–1000 mL)	0.54 (0.13–2.1)	0.37	0.5 (0.45–0.56)	0.78
Severe bleeding (> 1000 mL)	11 (7.9–15.3)	0.0001	0.56 (0.51–0.62)	0.03
Capillary refill time > 3.5 s	14.2 (10.5–19.3)	0.0001	0.72 (0.66–0.78)	0.001
Altered mental status	1.3 (0.7–2.3)	0.40	0.51 (0.45–0.56)	0.68
Respiratory rate > 25	4.3 (2–9.1)	0.0015	0.52 (0.46–0.57)	0.51

CI: confidence interval

Receiver operating characteristic (ROC) curves where constructed using a logistic regression for all vital signs registered

predictive accuracy. Consequently, CRT may serve as an early and specific indicator for clinical deterioration.

Pregnancy is associated with distinct hemodynamic changes. Interestingly, hypertensive disorders of pregnancy—a disease characterized by an altered microcirculation—have been shown to exhibit sublingual microcirculatory derangements, including a decreased percentage of perfused vessels, total capillary density, and functional vessel density, similar to those derangements found in septic shock [6]. In the latter, strong correlations have been established between prolonged CRT and sublingual microcirculatory abnormalities [7]. Thus, CRT could provide valuable insights into the microcirculatory status of the deteriorating obstetric patient. Given its simplicity, reproducibility, and zero cost, CRT has the potential to be seamlessly integrated into routine obstetric care. Nevertheless, further research is needed to validate its utility and optimize its implementation.

In conclusion, in a cohort of deteriorating obstetric patients in which a rapid response team was activated, an altered CRT was an accurate predictor of ICU admission and enhanced the predictive capacity of commonly used clinical scores used for triage. Bedside evaluation of CRT in obstetric emergencies emerges as a costless, simple and valuable tool for risk stratification. Future studies should further explore the utility and applications of CRT in this context.

Abbreviations

CRT	Capillary Refill Time
ICU	Intensive Care Unit
qSOFA	Quick Sequential Organ Failure Assessment
MEOWS	Modified Early Obstetric Warning Score
UVA	Universal Vital Assessment
ED	Emergency Department
RRT	Rapid Response Team
omqSOFA	Obstetrically modified qSOFA
SD	Standard Deviation
RR	Relative Risks
OR	Odds Ratio
AUC	Area Under the Curve

Supplementary Information

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Additional file1 (DOCX 103 KB)

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Author contributions
EMZ and EK conceived and designed the study. EMZ, MAHG, AM, JCBG, collected and verified the data. SM and EK did the statistical analysis. EMZ, MAHG, SM, GH and EK interpreted the data. EMZ, SM, RC, GOT, GH and EK drafted the initial manuscript. All authors critically revised the manuscript for important intellectual content and agreed to submit the final version for publication.

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Availability of data and material
De-identified patient data will be available with publication, upon reasonable request to the corresponding author.

Declarations

Ethics approval and consent to participate
This study was conducted in line with the principles of the Delcaration of Helsinki. The Institutional Ethical Review Board of the site approved this study (project ID DECS/JPO-CT-1140-2021) and informed consent was waived due to the observational nature of the study.

Consent for publication
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Competing interests
The authors declare no competing interests.

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